



Arabian Institute For Training

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# Modern Power System Protective Relaying

## INTRODUCTION

- This Modern Power System Protective Relaying training course has been designed to provide a clear and perfect understanding of power system protection schemes and devices, including protection relays, fuses, circuit breakers, and other protective devices. In modern power systems, nowadays, protection systems play a significant role in efficiently running plant operations, utility switching, industry load transfer, maintenance programs, and investment policies. The outcome is to minimize system outages and to keep the maintenance and repair costs at reasonable prices.
- Today, advanced protection devices are considered as Intelligent Electronic Devices (IED's) in all modern smart grids where protection schemes, logic, and relay settings rely heavily on a good understanding of communication protocols, inter-tripping schemes, etc. This will provide enough theoretical background in a simple language together with a step-by-step procedure to analyze electrical faults, their consequences, understanding of the characteristics of the time-current curves and the efficient numerical relay functionalities.

This training course will highlight:

- Electric Fault Types and Fault Calculations
- Electrical Protection Fundamentals
- Protection Relay Types and Functions
- Protection Logic and Settings
- Coordination of Protection Devices

## OBJECTIVES

By the end of this training course, the participants will be able to:

- Select fit-for-the-purpose protection relays and other related devices
  - Calculate fault levels and loadings of feeders and branches
  - Develop and analyze typical power systems and their associated protection systems
  - Analyze numerical relay protection for generators, transformers, motors, and transmission lines
  - Establish communication between protection devices and controllers
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## TRAINING METHODOLOGY

- This Modern Power System Protective Relaying training course will be presented by means of PowerPoint slides through which all the essential theory and equations will be provided, also includes case studies where the participants are required to take part in-class activities including system analysis, calculations, relay settings, etc., along with the use training videos for better understanding of the participants. The participants will be progressively assessed during the training course via quizzes, questions, assignments and worked examples.

## ORGANISATIONAL IMPACT

- Develop a structured approach and understanding of major protection schemes
- Ensure safe operation of the electrical equipment and installations
- Become familiar with testing and measuring instruments
- Ensure a sensible selection of protection functions and relay types for different operation scenarios
- Implement effective relay protection settings for different zones
- Calculation of fault levels and prospective fault current in a transformer

## PERSONAL IMPACT

- Power system analysis including load and fault studies
- Role of protective relaying
- Theoretical concepts and practical equations of power system protection
- Analysis and design of protection logic and schemes
- Relay functions and their applications and coordination
- The complexity of power system switching & operation together with proposed solutions for protection

## WHO SHOULD ATTEND?

This Modern Power System Protective Relaying training course is suitable for a wide range of professionals but will greatly benefit those who are involved in the operation, planning, design and maintenance of power systems.

- Project Engineers
  - Project Managers
  - Electrical Engineers
  - Electrical Technicians
  - System Operators
  - Design Engineers
  - Asset Engineers
  - Asset Managers
  - Planning Engineers
  - Planning Managers
  - Protection and Instrumentation Engineer
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## Course Outline

### Protective Devices and Earthing Systems

- Protection Zones and Time-current Characteristics Curves
- Per Unit System and Modern Software for Protection
- CT and VT Types, Specifications and Applications
- Fuse Types, Applications, Selection and Coordination
- Digital and Numerical Relay Functionalities
- Ungrounded vs. Grounded Systems

### Feeder Overcurrent and Earth Fault Protection

- Merits and Characteristics of Feeder Protection
- IDMT O/C & E/F Protection
- Definite Time (DT) Protection
- High-set Instantaneous Protection
- Transient Overreach
- Relay Settings

### Transformer Digital and Differential Protection

- Transformer O/C and E/F Protection
- Transformer Unit Protection (REF and Diff)
- Buchholz and Pressure Relief Operations
- Transformer Differential Protection Complexities & Solutions
- Unit and Non-unit Transformer Protection
- Digital Transformer Protection System

### Generator Protection, Directional Protection and Capability Curve

- Generator Faults and Protection Features
- Generator Protection Overview
- Generator Differential Protection (Biased & Unbiased)
- Generator Overall Protection
- Generator Full Protection with Numerical Relays
- Interpretation of Generator Capability Curve

### Busbar Protection and Distance Protection for Overhead Lines

- Digital Busbar Protection Schemes
  - Busbar High Impedance Protection
  - Frame Leakage Protection
  - Line Distance Protection
  - Line Differential Protection
  - Summary and Question & Answer
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